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XV. *Experiments to determine the Quantity of tanning Principle and gallic Acid contained in the Bark of various Trees.* By George Biggin, Esq. Communicated by the Right Hon. Sir Joseph Banks, Bart. K. B. P. R. S.

Read June 6, 1799.

THE bark of trees contains the astringent principle, called gallic acid, and also that principle which has a peculiar affinity to the matter of skin, and which, from the use to which it is applied, is called the tanning principle. But, in the present mode of tanning, bark is applied in *mass* to the skins; consequently, *both* principles are applied. It remains for examination, whether both principles are useful in the process of tanning; for, if they are not both useful, probably *one* is detrimental.

To a nobleman, whose zeal on every occasion by which the sciences or arts may receive illustration or improvement is eminently conspicuous, and to whose public energy, as well as private friendship, I feel myself much indebted, to his Grace the Duke of BEDFORD, I owe the means of prosecuting some experiments on this subject. His Grace, by collecting a variety of barks, at Woburn, gave me an opportunity of making some experiments to ascertain the quantity of tanning principle and gallic acid each bark contained. For that purpose, I made use of the following methods, according to the principles laid down by M. SEGUIN.

By dissolving an ounce of common glue in two pounds of boiling water, I procured a mucilaginous liquor, which, as it contains the matter of skin in solution, is a test for the tanning principle. By a saturated solution of sulphate of iron, I obtained a test for the gallic acid.

I then took one pound of the bark I meant to try, ground as for the use of tanners, and divided it into five parts, each part being put into an earthen vessel. To one part of this bark, I added two pounds of water, and infused them for one hour. Thus I procured an infusion of bark, which I poured on the second part of the bark, and this strengthened infusion again on the third part, and so on, to the fifth. But, as a certain portion of the infusion will remain attached to the *wood* of the bark, after the infusion is poured or drawn off, I added a third pound of water to the first part, and then followed up the infusion on the several parts, till the three pounds of water, or so much of them as could be separated from the bark, were united in the fifth vessel; from which I generally obtained about one pint of strong infusion of bark.*

To a certain quantity of this infusion, I added a given measure of the solution of glue; which formed an immediate precipitate, that may be separated from the infusion by filtering paper. When dried, it is a substance formed by the chemical union of the matter of skin with the tanning principle, and is, in fact, a powder of leather. By saturating the infusion with the solution of glue, the whole of the tanning principle may be separated by precipitation.

* The specific gravity of this infusion was ascertained by an hydrometer whose gradations are inverse to those of a spirit hydrometer.

FOR THE GALLIC ACID.

To the pound of bark left in the earthen vessels, and already deprived of its tanning principle by these *quick* infusions, I added a *given* quantity of water, to procure a strong infusion of the gallic acid, which requires a longer time, (say 48 hours.) This infusion, when obtained pure,* affords little signs of the presence of the tanning principle, when tried by the test of the solution of glue; but, with the solution of sulphate of iron, it gives a strong black colour, (the common black dye,) which differs in density, according to the quality of the bark: this may be further proved, by boiling a skain of worsted in the dye, by which the gradations of colour will be very perceptibly demonstrated.

Having thus obtained a point of comparison; by making a similar infusion, under similar circumstances, of any bark, or vegetable substance, and paying strict attention to the specific gravity of the infusion, the quantity of precipitate of leather, and the density of colour produced by given quantities of one or the other test, the result will be, a comparative statement of the respective powers of any bark, or vegetable substance. This comparative statement, I conceive to be sufficient for all commercial purposes.

As oak bark is the usual substance employed in the trade of tanning, if a quantity of tanning principle is found to be contained in any other bark or vegetable, the commercial utility of

* It is hardly possible, from the intimate connection of the two principles, to separate them entirely by infusion: in the infusion of tanning principle, there will always exist a little gallic acid; and, in an infusion of gallic acid, a little tanning principle will commonly be present, unless the infusion of gallic acid is very weak, and procured by a third or fourth watering.

that bark or vegetable may be determined, by comparing its quantity of tanning principle and price with those of oak bark.

For an accurate chemical analysis, I have tried a variety of acids, and simple and compound affinities; and, having pursued the above experiments, at the same time that I was employed on some in dying, I found the muriate of tin (the method of using which is described by Mr. PROUST in the *Annales de Chimie*) very convenient. A solution of it, being added to the infusion of bark, forms a precipitate with the tanning principle, leaving the gallic acid suspended: the precipitate is of a fawn colour, and is composed of tanning principle and oxidated tin.

By these means, I have been enabled to form a comparative scale of barks; which, however, I do not produce as accurate. Oak bark, in its present state, as procured for commercial purposes, differs very much in quality, from accidental circumstances: the season of the year in which it is collected occasions a still more important difference, consequently, the scale now produced must be very imperfect; but I am of opinion, that by the pursuits of scientific men who may be inclined to investigate this subject more fully, a very accurate scale may hereafter be formed.

In the following scale, I have taken Sumach as the most powerful in the comparative statement; leaving, however, a few degrees, for a *supposed maximum of tanning principle*, which I reckon 20.

SCALE OF BARKS.

Bark of	Gallic acid, by colour.	Tanning prin- ciple, by hy- drometer.	Tanning princi- ple, (in grains,) from half a pint of infusion and an ounce of solution of glue.
Elm* - - - - -	7	2,1	28
Oak, cut in the winter - - - - -	8	2,1	30
Horse chesnut - - - - -	6	2,2	30
Beech - - - - -	7	2,4	31
Willow (boughs) - - - - -	8	2,4	31
Elder - - - - -	4	3,0	41
Plum-tree - - - - -	8	4,0	58
Willow (trunk) - - - - -	9	4,0	52
Sycamore - - - - -	6	4,1	53
Birch - - - - -	4	4,1	54
Cherry-tree - - - - -	8	4,2	59
Sallow - - - - -	8	4,6	59
Mountain ash - - - - -	8	4,7	60
Poplar - - - - -	8	6,0	76
Hazel - - - - -	9	6,3	79
Ash - - - - -	10	6,6	82
Spanish chesnut - - - - -	10	9,0	98
Smooth oak - - - - -	10	9,2	104
Oak, cut in spring - - - - -	10	9,6	108
Huntingdon or Leicester willow	10	10,1	109
Sumach - - - - -	14	16,2	158

* The infusion of elm was so loaded with mucilage, that it was with difficulty I could separate the tanning principle, or try the specific gravity.

It is to be observed, that the barks do not keep any respective proportion in the quantity of gallic acid and tanning principle contained in each; which is an evidence of the distinctness of principle, and may perhaps open a new field for saving oak-bark in dying, as the willows, sallow, ash, and others, produce a very fine black. It is also worthy of observation, that the quantities of gallic acid and tanning principle do not differ in *equal* proportions, between the winter and spring felled oaks. This fact may lead to the discrimination of the proper time for cutting; which is, probably, when the sap has completely filled and dilated that part of the vegetable intended for use. This will make a difference in the season of cutting oak, elm, and other trees, shrubs, &c. Leaves should be taken when arrived at their full size, and then dried under cover; for, as the tanning principle is so soluble, and the substance that contains it so thin, (in a leaf,) the dew alone might dissolve it.

Finally, as the gallic acid does not seem to combine with the matter of skin, and as its astringency will corrugate the surface, we may, I think, conclude, that its presence in tanning is not only useless, but detrimental.